PEP vs 6-GeV

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There has been some feeling that a PEP upgrade might reduce the need for a 6-GeV synchrotron source. In this note we compare the two sources from a user viewpoint.

More tham a year ago PEP substitution for a 6-GeV ring was considered by the users, and a request was made to H. Wiedemann of SSRL to evaluate this. I will draw heavily from his evaluations in this note.

There are six long and six short straight sections on PEP. The long straights occupy HEP experiments at present, but are likely to be vacated soon. (Perhaps 2 in the summer of 1986.) One short straight (#5) has been given to SSRL for its enhancement program where an undulator is being built.

In Table 1 we compare some of the parameters for the PEP with the Argonne 6-GeV design.

TABLE 1

	PEP	6-GeV
Beam energy (GeV)	E=8.0	E=6.0
Emittance ε_x (rad m)	1.1×10^{-8}	6.5×10^{-9}
Coupling	10%	10%
Beam size σ_x (μm)	1683	384
σ_y (μm)	72	64
Divergence σ_x' (mrad)	65×10^{-3}	15×10^{-3}
σ_y' (mrad)	15×10^{-3}	9×10^{-3}
Current at 14.5 GeV	40 mA	-
Current at E GeV	100 mA	100 mA
Lifetime at 14.5 GeV	4 hrs.	-
Vacuum (E GeV,100mA)	30 n Torr.	< few n Torr
Lifetime at E GeV	$\lesssim$ 1 hr	$\approx$ 5 hrs
Straight sections	$\sim$ 12	28
Bending magnet sources	-	32

It is not feasible to use the 8-GeV PEP as a dedicated high brillance source which would perform like a planned 6-GeV source for many reasons.

1. Short life of the stored beam. This can only be improved through an improved vacuum system producing at least an order of magnitude better vacuum (or through an increase in the emittance and a lowering of the current!!).
2. The emittance is nearly a factor of two poorer and this will decrease the brillance by a factor of four compared to that expected from a 6-GeV source. The beam size and divergence indicates even poorer performance.
3. The users will have to be contented with poorly accessible radiation from only 12 straight sections.
4. Bending magnet radiation will not be available because of the magnet structure and the under-the-hill placement of the ring.
5. With wigglers of field more than 0.164T, the electron energy spread will be large and a beam loss may result due to chromatic effects.

To substitute the 6-GeV ring with the 8-GeV PEP, major revisions are needed. This may involve changes in the lattice and is to be evaluated by accelerators physicists. The cost of this is as yet not known. The exact cost of operating the PEP ring as a dedicated SR source is also not known, since part of the electricity bill came from HEP detectors. But the present estimate is about 0.5M$ per month, using the old rate for the electricity cost.

In conclusion, it appears tht the PEP-ring, at best, will be a useful source for carrying out 6-GeV R&D work (related to accelertor physics and beamline optics) rather than a replacement for a 6-GeV source.